HW 7 Coloumb's Law

1. How many electrons make up a charge of $-30.0\mu C$?

$$-30\mu C(\frac{10^{-6}C}{\mu C})(\frac{6.24*10^{18}e}{C}) = \boxed{1.87*10^{14}electrons}$$

2. Two charged smoke particles exert a force of $4.2E-2N$ on each other. What will be the force if they are moved so they are only one eighth as far apart?

$$F = \frac{|kq_1q_2|}{d^2}$$

Therefore, the force increases by the inverse square of the factor of decrease in distance. So, the force is sixty-four times as large when the distance is one-eighth.

$$0.042N(64) = \boxed{2.69N}$$

3. Two charged Ping-Pong balls separated by a distance of 1.50 m exert an electric force of 0.02 N on each other. What will be the force if the objects are brought to a separation of only 30.0 cm?

$$\frac{30}{150} = \frac{1}{5}$$

$$F = \frac{|kq_1q_2|}{d^2}$$

Therefore, the force increases by the inverse square of the factor of decrease in distance. So, the force is twenty-five times as large when the distance is one-fifth.

$$0.02N(25) = \boxed{0.5N}$$

4. What is the magnitude of the electric force of attraction between an iron nucleus ($q = 26e$) and its innermost electron if the distance between them is $1.5*10^{-12}m$?

$$q_1 = 26e\frac{C}{6.24*10^{18}e} = 4.17*10^{-18}C$$

$$q_2 = -e\frac{C}{6.24*10^{18}e} = -1.60*10^{-19}C$$

$$F = \frac{|kq_1q_2|}{d^2}$$

$$F = \frac{|8.99*10^9Nm^2/C^2(4.17*10^{-18}C)(-1.60*10^{-19}C)|}{(1.5*10^{-12}m)^2} = \boxed{0.00267N}$$

5. What is the force a $15\mu C$ charge exerts on a 3.0 mC charge 40 cm away?

$$F = \frac{|kq_1q_2|}{d^2}$$

$$F = \frac{|8.99*10^9Nm^2/C^2(15*10^{-6}C)(3*10^{-3}C)|}{(0.4m)^2} = \boxed{2530N}$$

6. A person scuffing her feet on a wool rug on a dry day accumulates a net charge of $-60\mu C$. How many excess electrons does this person get, and by how much does her mass increase?

$-60\mu C(\frac{10^{-6}C}{\mu C})(\frac{6.24*10^{18}e}{C}) = \boxed{3.74*10^{14}electrons}$

$m_e = 9.11*10^{-31}kg$

$3.749*10^{14}*9.11*10^{-31}kg = \boxed{3.41*10^{-16}kg}$